Rafa de Ameller:

Hi folks, I'm Rafa de Ameller, Rafa, I'm the lead for the NOAA Environmental Visualization Lab. I'm going to start my presentation by talking a little bit about this amazing agency, the National Oceanic and Atmospheric Administration, also known as NOAA, and just a little bit about what we do. As you can see, I'm talking there about observing and understanding Earth systems, from the surface of the sun to the depths of the ocean. So I'm going to start my presentation here with the sun. Yes, at NOAA, we are continuously monitoring solar activity, and anytime that we see something coming off of the sun, a flare or a coronal mass ejection, we're then tracking it through space and forecasting where it might hit. This is done because we want to make sure that anything that might be stronger than your usual solar wind, like a coronal ejection or a flare, if it is coming towards Earth, there are things that we need to do with satellite communications, and electric grid operators, and things like that. But we do have a strong magnetosphere that protects us against this continuously.

As we travel through space and we get closer to the Earth, we can see it here, Earth in true color. This is imagery from our geostationary satellites, I'm going to be talking about them a little bit more, but these are satellites that I work with every day. They are NOAA's weather satellites. What we're doing is we're continuously monitoring the Earth, and what we see here is the atmosphere of the Earth, the very dynamic atmosphere of the Earth, and within NOAA, there's the agency National Weather Service that issues all those watches and warnings, and the forecasts that everybody in the US, and data that everybody in the world uses to be able to protect life and property, and stay safe from severe weather. As we dive in into the oceans, again, from the surface of the sun through our atmosphere into our oceans, what we're seeing here are sea surface temperatures. We continuously monitor all aspects of the ocean, from salinity to dissolved oxygen, sea surface temperatures, temperatures at depth, and we do this to be able to look at the patterns, look at whatever might be out of the normal.

Events like El Nino, which is starting to unfold right now, and which actually have global climate consequences as this cycle reoccurs all the time. All the way into the depths of our ocean. At NOAA, all the topography of the Earth and the bathymetry, that's the underwater topography. We also monitor that and map it out so that everybody in the world can have the exact positions of everything located on the Earth. And how do we do all these things at NOAA? Well, the majority of the work that we do is having folks deploy things like buoys in the ocean, we also have folks that are at sea or in the air, like our hurricane hunters, flying into tropical storms and hurricanes to get data there, so that we can better predict and forecast where that hurricane might be going. And here we have an oldies picture of folks releasing a weather balloon into the air. That is also an in C2 measurements. These are all measurements that are done with sensors that are in contact with the air or with the water, and they're measuring humidity, temperature, wind direction, and wind force.

But of course, it would be very impractical to cover the whole Earth in sensors, or imagine having buoys covering the whole Atlantic, where you could just jump from one buoy to another to get somewhere, that's completely impractical. But the only way to monitor properly is by using these technologies, and this is where remote sensing comes in, where our satellites come. In the same way that a thermometer in your mouth gives you the temperature of your body, now we've become used to seeing these contactless thermometers that we point to our forehead and they'll give us a reading of our temperature in the back. This is really remote sensing, in this same way, rather than NOAA logos to my satellite here, we're continuously monitoring the Earth, and collecting data from the Earth. The vast majority of data that we collect is right now from satellites.

As satellites orbit the Earth, or stay in geostationary orbits, or closer low Earth orbits, they're continuously collecting that data, and making it available so that we can get the perfect picture and understanding of how the Earth looks now, how it has looked in the past, and to be able to predict how it's going to be looking in the future. That past archive, that's our climate record, and being able to look at the future is either short-term forecasts, like what you get from the National Weather Service, or longer term forecast that you get from climate services that NOAA delivers, where we're looking at how things might be looking in the year 2100. Here's a satellite orbiting the Earth. This is one of our JPSS satellites. As you can see there, as the Earth comes out of the shadow, you can see that the satellite, as it orbits the Earth, it's just continuously scanning the Earth for data, and uploading that data, and at the same time, broadcasting that data out to whomever might have a satellite receiving station over the Earth at that time.

This is a constellation of satellites that includes also GPS satellites, and other non-NOAA satellites. And what I'm going to do here is we're going to turn off some of these other satellites that are in there, and we're going to leave the NOAA's primary satellite fleets, which are the polar orbiting satellites. We call them that way because they're orbiting around the poles, and the geostationary satellites, which as you can look there, they look more static in space, and they are actually orbiting the Earth at the same time than the Earth rotates on itself. So that's continuous imagery that's being captured. Now, why does... Well, here you can see before and after. As technology improves, we can not only get the Earth in high definition, better imagery, but it's also the amount of imagery that we receive. All the spectral bands, we're looking at the Earth in more than just the visible imagery. We're looking at infrared, and trying to get all the information that we can from that environmental information, and we do all that so that we can monitor this.

These are our supply route, and the travel roots, and all the commerce route around the world. Anytime that something goes from one place to another, you got to know how things look en route, and how things look when you're going to be arriving at your destination. Now, all this data that's continuously being collected by NOAA, all this environmental data, it's masses and masses of data as you might imagine, and NOAA has several archives out there, as I was talking about that climate archive, how the Earth has looked in the past, there's real time data continuously coming in, observations from satellites and from different locations, and then there's forecasts, things that we're continuously putting into supercomputers to be able to forecast how the Earth and these Earth systems, the atmosphere, the hydrosphere, is going to look into the future. All that data combined creates these gigantic archives, and a way to access them, the way to access the raw data, if you may.

If you go to data.noaa.gov, here's your entry portal where you can see the NOAA data catalog, and the more modern one-stop tool that presents you already with featured data sets up here upfront. And if you click on any of the themes, or if you put in any search terms, you'll be able to find extensive information on how to access different data sets. These point to our primary dissemination points. Many, many times, a lot of these dissemination points though take you to either very raw data, if you may, or data archives where the data isn't readily interoperable, and I'm going to show a few examples of that. And I'm going to focus on our geostationary satellites, and also, I'll show something about our polar orbiting satellites. Here, I'm on the NESDIS website. NESDIS is part of NOAA, just like National Weather Services, NESDIS is the National Environmental Satellite, Data, and Information Service. Now, it's important to note that there's a comma between satellite, data, and information. The satellites, we operate them just like NASA operates their Earth observing satellites.

We also have a Houston, we don't put people in space, but we do put satellites and operate them in space. The data is all that archive of data that I was talking about. We have the National Center for Environmental Information, as well as multiple ways to disseminate the data, and information is like information products that come from looking at the data and analyzing the data. So focusing on that goes satellite imagery. The typical access, as I showed before, is like to the raw data, more modern platforms that NOAA makes available allows you to access the different sectors of the data. I'm going to click on CONUS, that's the contiguous US, and you'll see here that there's a broad selection of imagery and different band combinations from satellite that allow you to see different things, like dust and other things in the atmosphere, without really having to do much more manipulation of the imagery. But this is very stove piped. Okay, so I got the image, I can download the image, but it's not really a geospatial product.

The same thing with this tool here. This is called the RAMMB Slider, an awesome tool. This is actually the view that you get from the satellite itself. This is how Earth looks from space from that satellite. And what you can see here is that, yes, I can look at the latest satellite data, and it's animating, and it's looping for me, and I can choose another satellite here by going through any of these options. Let's look at GOES-West, for example, that's the satellite that's over the Pacific. And you can see there that most of that is dark right now at this time, the sun hasn't come up over the Pacific at this time, and these are very useful tools to be able to look at the data, and play back and forth, and look at how the data looks like. But this is very stove-pipe. I cannot readily make this data interoperable, I can't add it to other data sets.

And that's a problem, because as much as I look at this data, and as much as I want to exploit that, and maybe look at things like where the dust is and everything, for an average user, a non-scientific user that's not used to manipulating multidimensional data, which is how we store the data from the satellites, what they need is something that's more interoperable, accessible, understandable, and that's where geospatial data comes in. And here, the same data imagery that I was showing before from the GOES satellite is here on top of a 3D globe. But in this case, what we're doing is the VizLab has geospatial services, where we make these data sets available in a way that's interoperable, and that is thanks to the power of geospatial information. Other examples on the NESDIS website include things like our hurricane tracker, which, if I go to it now, it will load and you'll see that it not only has that satellite imagery that I was talking about, but it also has where the cone of uncertainty and the past track of storms might be in the Atlantic and in the Pacific.

If you click on any of these information, or if I bring up the legend, you'll see that I get a lot of information that goes together with the imagery when I combine it with other useful data. Seeing these hurricanes, and the tracks, and where they're going is something that I would not be able to do in the traditional stoved pipe viewers, so that's where these data services really distinguish themselves. Yes, I can see the real time data here, but I can't really do much more with this. I would not be able to put the hurricanes on this, if it weren't available as a service, as I'm showing here. Now, where can you access these services? We have what's called NOAA's GeoPlatform, that's our slice of ArcGIS Online. It's noaa.maps.arcgis.com, or just look for NOAA GeoPlatform, and there... I'm signed in right now because I'm a user of the platform, but even without being signed in, you have access to everything because we make all our data open, and accessible, and free for anybody to use.

And as you perform searches on the platform, if you're looking for satellite imagery, you'll see that there's a lot of things that come up no matter where you are on the NOAA GeoPlatform. And one of the things that I wanted to show is also this heat.gov. So going from the global satellite imagery, and how we make that available as image services for geospatial viewers and for that interoperability, we going a little more local, looking at local impacts, heat.gov is an interagency group led by NOAA that looks at understanding heat related illness and deaths, and how they're preventable by just doing some better urban planning. What you see here is the current actual map of all the heat alerts across the US, and there's plenty of them going on. Excessive heat warnings in the South West. And of course, it's making folks get these alerts and warnings, that's our main goal. Again, protecting life, property, and economic vitality. But part of it too is also helping folks face a changing climate. One where events like these excessive heat warnings are more frequent and can become deeper.

And to that effect, what NOAA has been doing is we've been funding some urban mapping campaigns, where what we're doing is we're mapping out urban heat islands. Now urban heat islands, the traditional view of an urban heat island is the center of the city is hot and the rural areas around our cooler. And that's true, but that doesn't tell the whole story. As that fidelity of our observations, what I was showing before, as we improve our technology on how to observe the environment, and we use other techniques, like here we're using citizen scientists who volunteered in their cities to map out their city, their urban heat island on their city, and you'll see that they're using these sensors that they're putting on their cars, and then they start driving around predetermined routes. And what that gives us is a picture of how that urban heat island looks in over 60 cities across the US, starting with Washington, DC and Baltimore, I think we're the first two ones, that was back in 2017.

And already over the years, we've been mapping many, many other cities, and it lets us really slice into how that urban heat looks within the city. Because one important thing to note is that heat is distributed unequally across the city. And when you look at cities like Washington, DC or... I'm just going to start scrolling down this story map, which is available on the NOAA GeoPlatform, and this takes you through the different neighborhoods in Washington, DC. From the coolest neighborhood to the hottest neighborhood. And again, this is all thanks to geospatial data. These heat map surfaces are not just being made available as, "Go ahead and download it, and use it whichever way we want." These are being made available as map services that allow us to add them into maps, do these kind of interesting story map tours that let us look at the city and different parts of the city, which is hottest, which is coolest, but also slice into that social economic profile. Who lives in these different neighborhoods, in the hottest and the coolest areas. And when we look at other cities, here we have San Diego.

In San Diego, it has a very interesting profile because the downtown is very cool, thanks to the cool air coming off of the Pacific, but it very quickly becomes warmer as you go inland, and then much warmer as you go towards the desert areas. But even within the city itself, you can see that there is an unequal distribution of heat. When we bring in socioeconomic data that we get from the Census Bureau, we can really slice into how these different census tracks look like. This is San Diego again, using that heat island data, which again, our image services, this is really very advanced because we're going beyond your traditional analysis using vector layers, like points, polygons, and lines. Here we're slicing into satellite data that's been combined with... You see these little squiggly lines that go around here? These are the roots that these volunteers followed on that very hot day, and registered the temperature across the city.

And this, with artificial intelligence and high resolution satellite imagery, give us these heat surfaces, which we can then slice and dice, and bring in that census data, and get a little more information over which areas we should be doing some mitigation, like where should we be deploying cooling centers in this city. These maps really give you that profile very quickly to understand where folks at risk might be versus... And that includes folks who might not have air conditioning units or that have underlying diseases. So this long tail of different products and services that we produce also has some nice elements, like being able to do VR. This animation, this movie here, Eric Hackathorn is a colleague of mine at NOAA, he's at the Global Systems Lab, part of OAR, that's Oceans and Atmospheric Research at NOAA. And there, you can see he's put on his goggles, and this is the Oculus device, which is from Meta, formerly Facebook, and he's going to start that VR experience, which allows you to go through Washington, DC by going through a series.

Those different waypoints that we were looking before, but a little more interaction, and the story combined with it. So here, we're combining GIS data from NOAA and GIS data. The buildings, and the imagery, those are coming from... The buildings are coming from Washington, DC, where the trees are located atm that's also being made available by Washington, DC. The high resolution satellite imagery under the heat is also there for us to be able to locate where things are, and then bring it together, not just as a story, but as an experience that allows folks to understand this unequal distribution of heat across cities, and doing this from grassroots organizations to the top level engineers that might be working in the city, who still need to understand how these things work. A lot of the other efforts that NOAA does regarding geospatial data, National Weather Service has their integrated dissemination program. This is making sure that all those data that I was talking about, there are critical real time, like watches and warnings, or the quantitative precipitation forecast, where are they estimating that there's going to be a lot of rain falling, and things like that.

All these are being made available in real time as geospatial services as well. So with that, I'm going to conclude my presentation and see if anybody has any questions. Thank you very much.

Carten Cordell:

Great. Thanks, Rafa. Give a couple moments for questions, but I did want to say with all the data that you make available, as we saw with the VR presentation, it seems like a lot of grist for the mill of innovation.

Rafa de Ameller:

Yeah, that's right. It's about being able to... Innovative ways of using geospatial data to bring it closer to everybody who's never really been exposed to that data.

Carten Cordell:

Excellent. Well, it doesn't look like we have any questions right now, so now we'll take a short coffee break, and we will see you back here at 10:15.

Rafa de Ameller:

Excellent. Thanks everyone.